Re-engineering Legacy Avionics Components

Ted Riffle
Battelle
505 King Avenue
Columbus, Ohio 43201
(614) 424 - 6126
Rifflet@battelle.org

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Background

- Average age of US military aircraft is 20+ years and increasing [1]
- In 1990's USAF aircraft readiness decreased from 83% to 73% [1]
- Aging legacy avionics are a major contributor
  - Low reliability, high maintenance costs
  - Diminishing manufacturing sources (DMS)

[1] Committee on Aging Avionics in Military Aircraft, 2001, Aging Avionics in Military Aircraft, Washington D.C., National Academy Press

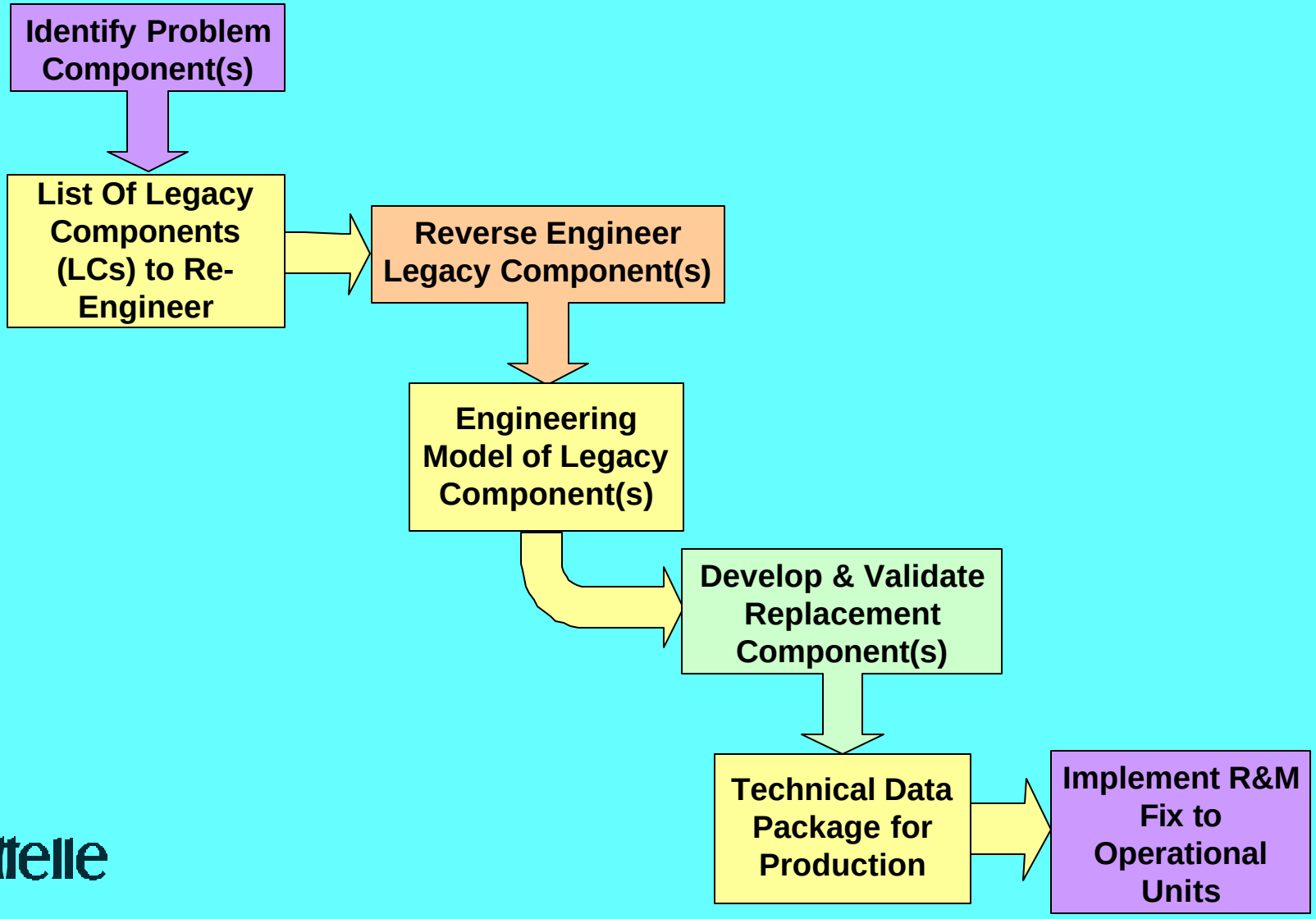
“Legacy” Definition

- Dictionary -- “*Something handed down from an ancestor or a predecessor or from the past*”
- Avionics -- existing line replaceable unit (LRU) or shop replaceable unit (SRU) that must be replaced without impacting the other LRUs or SRUs or other interfaces ‘around it’
  - To expensive to do a full avionics (entire aircraft) system re-design
  - Typically an avionics legacy component replacement is a form, fit, function, interface (F3I) compatible replacement

Problems Encountered in Re-engineering

- Legacy component is not well documented
- Existing documentation is inaccurate
- Obsolete functionality within the legacy component
- No documented test procedure or test capability for legacy component
- Very low quantities of replacement components are required

Re-Engineering Process



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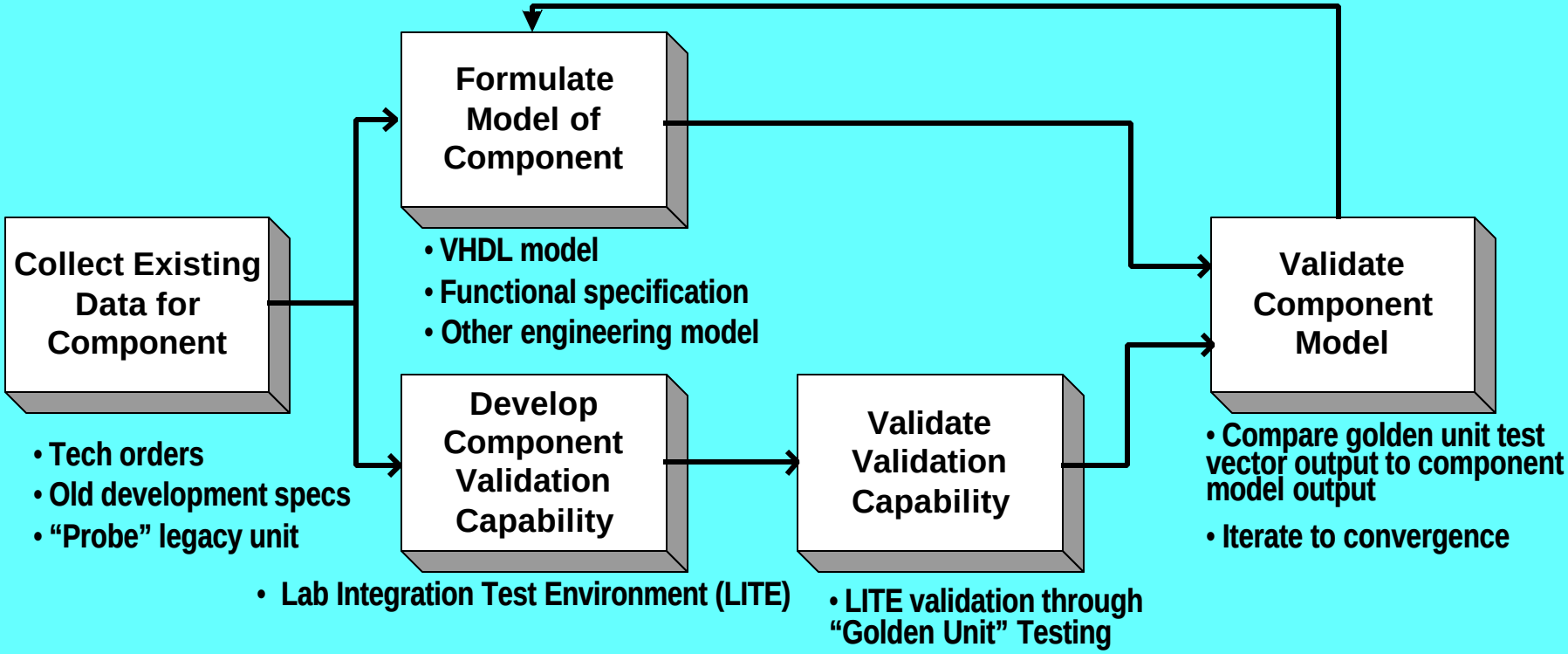
Identify Problem Components

- Low reliability, high maintenance cost items
- Air Force databases
  - Reliability and Maintainability Information System (REMIS)
  - Core Automated Maintenance System (CAMS)
  - Standard Base Supply System data
- Air Force Total Ownership Cost (AFTOC) [3]

[3] Hitt, Ellis and Jerry Schmidt, 1999, Air Force Total Ownership Costs (AFTOC) and Reduction in Total Ownership Costs (R-TOC), 18th Digital Avionics Systems Conference

Reverse Engineer Legacy Components

- Need to develop a validated model of the legacy component



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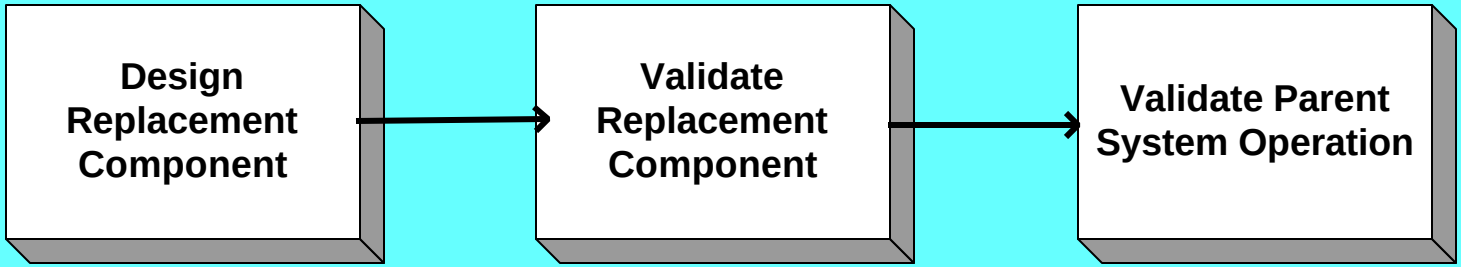
Develop & Validate Replacement Component



- Standard engineering design practices
- Use validated LITE
- Avionics Integration Support Facility

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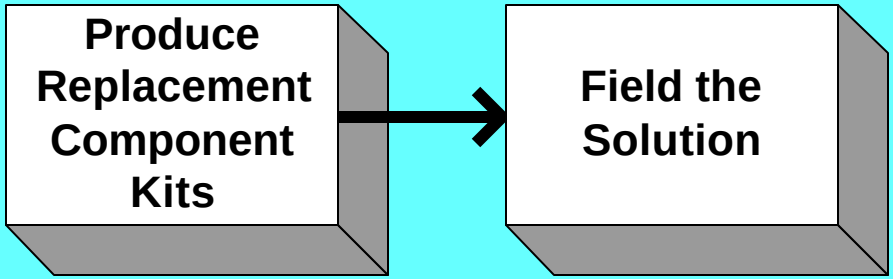
Implement R&M Fix to Operational Units



- Manufacturing

- Technical Order updates
- Installation
- Training

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Re-engineering Example
A-10 Digital Stores Management System

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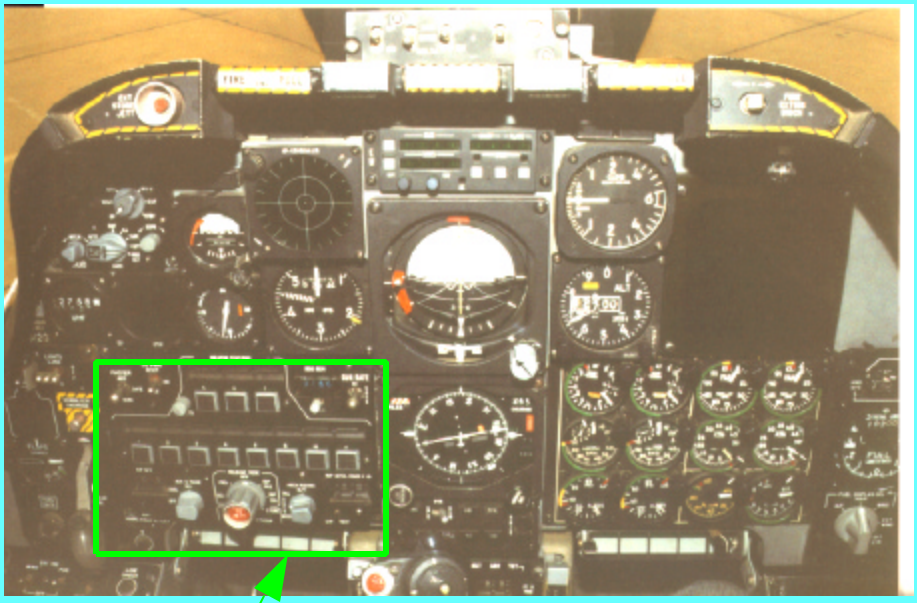
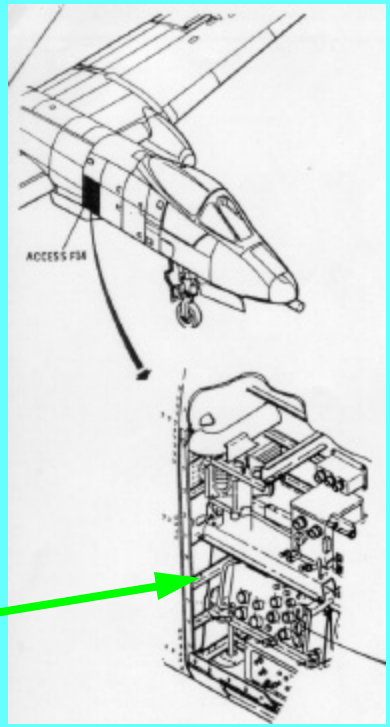
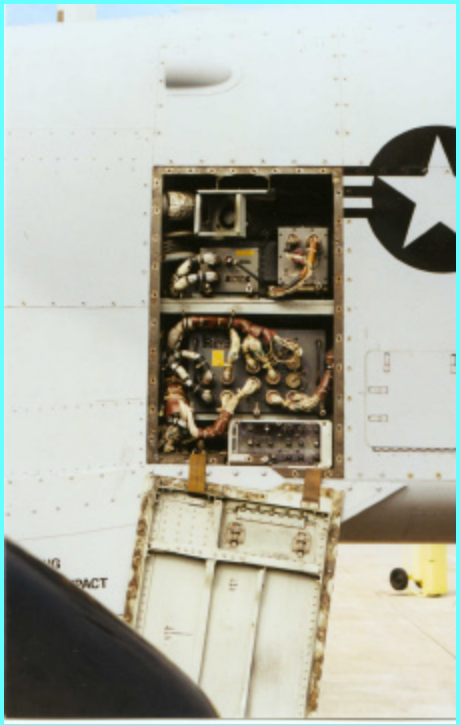
A-10 Armament Control System (ACS)



Armament Control Panel (ACP)



Interstation Control Unit (ICU)



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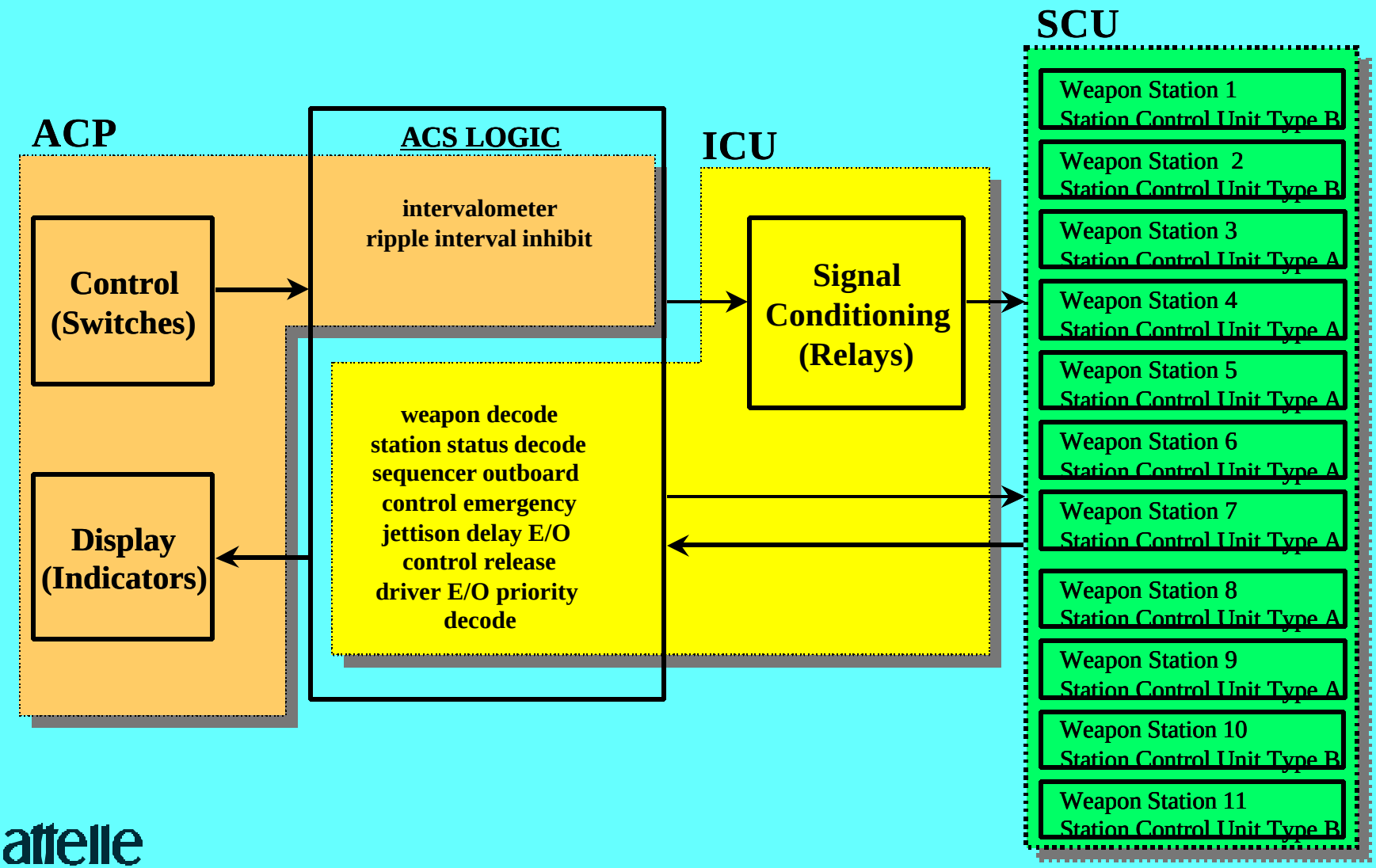
A-10 ACS Electrical Architecture



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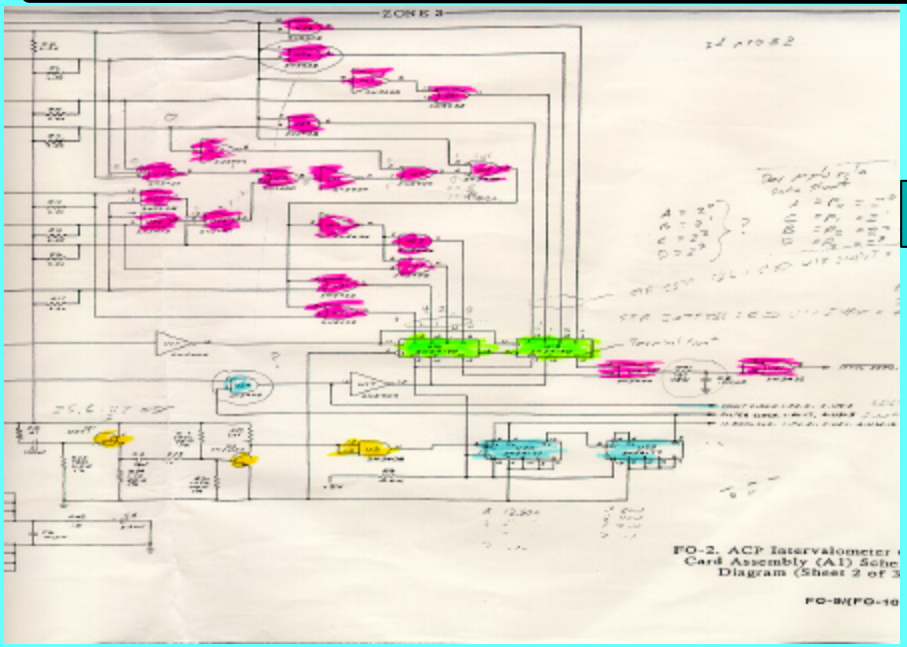
Engineering Model Development



Schematic

VHDL code

```
 COUNT8 <= COUNT_NOW16;
--u18 as a process
MSD_TMP(3) <= MSD8;
MSD_TMP(2) <=MSD4;
MSD_TMP(1) <=MSD2;
MSD_TMP(0) <=MSD1;

PROCESS (N_COUNT_CLOCK, N_INTERVAL_LOAD, rco_out)
 BEGIN

    IF   (N_INTERVAL_LOAD ='0')   THEN
         COUNT_NOW18 <= MSD_TMP;

    ELSIF  N_COUNT_CLOCK'EVENT AND N_COUNT_CLOCK ='1'  THEN
        IF rco_out = '0' THEN
            count_now18 <= count_now18 - '1' ;
        END IF;
    END IF;

END PROCESS;

--    IF count_now18 = "0000" THEN
--        maximum_MSD <='1';
--    ELSE
--        maximum_MSD <='0';
--    END IF;

 maximum_MSD <= NOT count_now18(0) AND NOT count_now18(1) AND NOT count_now18(2) AND NOT count_now18(3);

 COUNT8 <= COUNT_NOW18;
 c18 <= maximum_MSD;


 rco<= rco_out;

  N_Interval_Zero <= NOT ( maximum_LSD AND maximum_MSD  ); ---after 1.51 microseconds

  N_Intvl_Zero_P1_8 <= N_Interval_Zero;

N_STORE_JETT_SEL <= NOT Str_Jett_Sel_P2_8;

PR4  <= (N_STORE_JETT_SEL AND FILTER_OUT );

U28_J <= (
              NOT N_LOAD
              OR
              (
                  N_STORE_JETT_SEL
                  AND
                  NOT N_INTERVAL_ZERO
              )
          );
```

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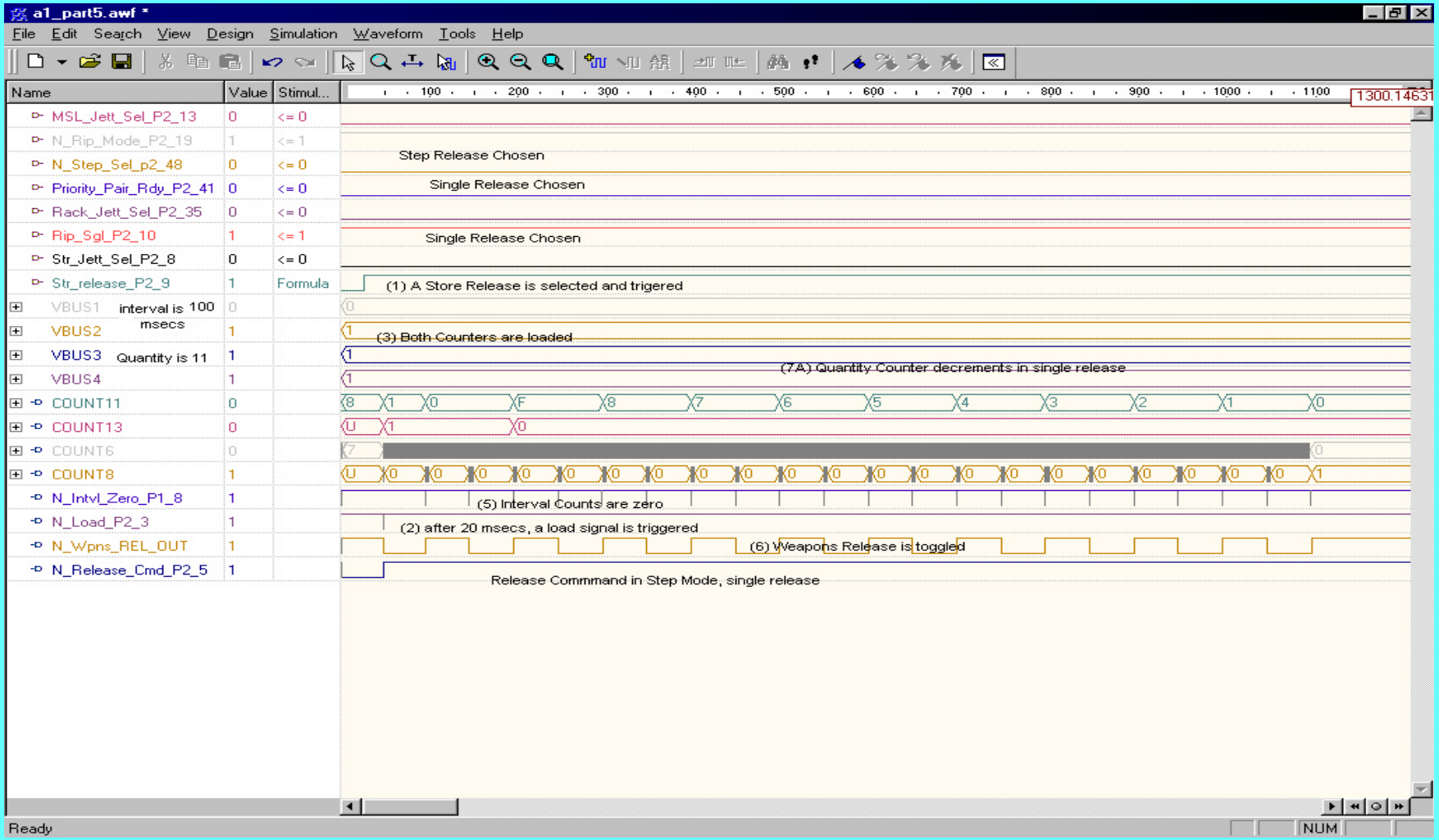
Virtual Test Environment



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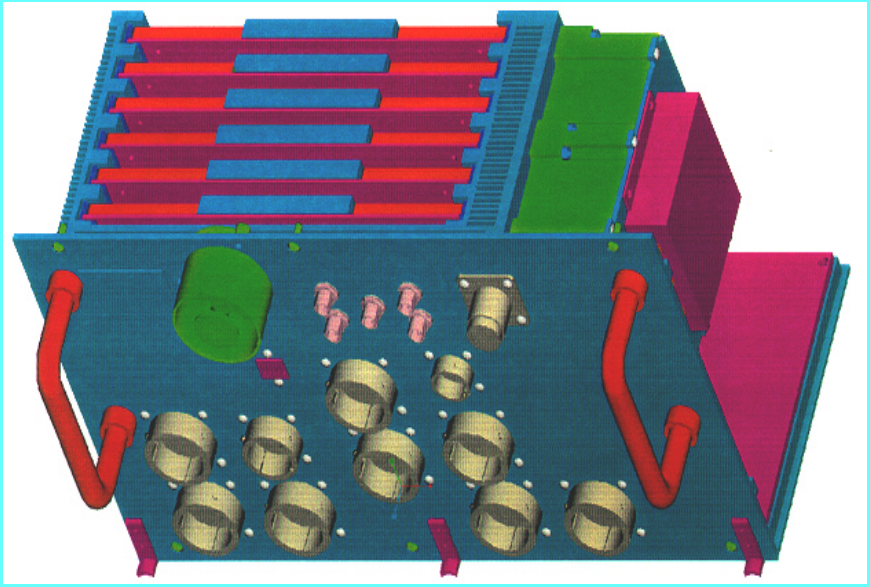
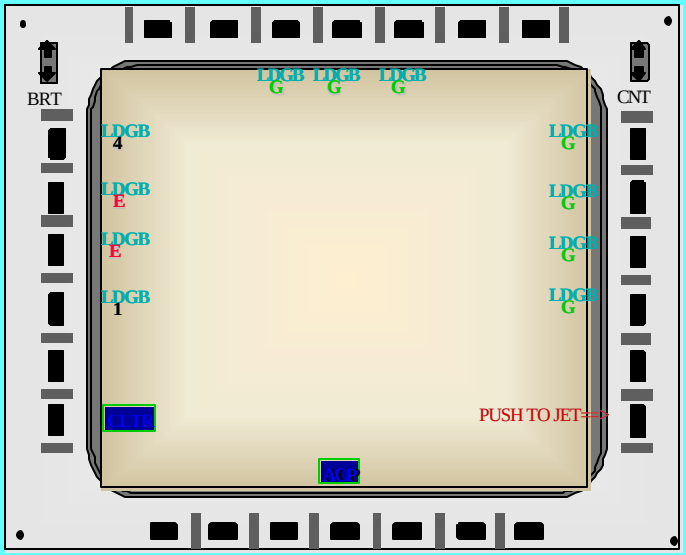
“Real” Test Environment

A-10 Lab Integration Test Environment

A-10 Digital Stores Management System (DSMS)





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